PLANTERS' BULLETIN

OF THE RUBBER RESEARCH INSTITUTE OF MALAYA

NEW SERIES NUMBER FOUR

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R R I

LOCATION The Institute's Laboratories and Offices are at the third mile, Ampang Road, Kuala Lumpur.

CORRESPONDENCE All *letters* must be addressed to the Director, Rubber Research Institute of Malaya, Post Office Box 150, Kuala Lumpur. Special inquiries may be marked for the attention of a particular officer, if so desired (See Staff List in Bulletin No. 1, page 24). The address for *telegrams* is Searching, Kuala Lumpur. *Telephone:* Kuala Lumpur 3351/2/3. *Parcels* occasionally arrive without any indication of their origin. It is requested that senders will write their names and addresses clearly on the outside of all packages, and also advise the Institute by letter or telegram of their despatch. This is especially important for perishables, such as latex samples and plant specimens.

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ADVICE Inquiries are invited from rubber producers in the Federation of Malaya, the Colonies of Singapore and North Borneo, and the territories of Sarawak, Brunei and Nigeria, who may require more detailed information applicable to their own special problems. *Interviews* should be arranged by letter or telephone, as members of the senior research and advisory staff are frequently absent on visits to plantations. The Institute is open from 8 AM to 1 PM and 2 PM to 4 PM on Mondays to Fridays, and from 8 AM to 12.30 PM on Saturdays.

EXPERIMENT STATION AND FACTORY This station of the R R I is situated 16 miles from Kuala Lumpur, at Sungei Buloh on the Kuala Lumpur — Kepong — Kuala Selangor road. Visits may be made on Mondays or Wednesdays by arrangement with the Director of the Rubber Research Institute (see *Correspondence* above). There is a guest house.

PLANTERS' BULLETIN

OF THE RUBBER RESEARCH INSTITUTE OF MALAYA

Kuala Lumpur January 1953 New Series No. 4

Editorial: The Soils Division

The investigation and solution of soil problems is fundamental to the growing of good rubber trees, and the task of the soil scientist in the rubber plantation industry is to discover the best way to treat any individual soil in order that it may grow and maintain healthy rubber trees.

The problems of the soil are investigated both in the field and in the laboratory. In the fieldwork of the Soils Division, fertiliser trials feature largely. By girth and yield improvements, the response of the rubber tree is ascertained to different types and qualities of fertilisers, applied at different rates and times and in different ways. The number of field experiments conducted by the Soils Division at the Experiment Station and on estates throughout the country amounts to over fifty. Over one hundred and fifty thousand girth measurements and twentyfive thousand yield records are taken and examined each year in connection with these experiments.

The problem of maintenance of soil fertility involves the study of cover crops and of measures to prevent soil erosion. The relative advantage of leguminous *versus* non-leguminous types, and of planted *versus* indigenous species, have been examined in the field. Soil cultivation treatments have always to be considered in relation to the possible damage to the soil which may result from the effects of erosion or because of loss of texture and of other physical properties of the soil. Developing from these studies, investigations have been made of weed control by spraying with herbicides and by using mechanical equipment, and also of the possibilities of more general use of machines for cultivation operations on rubber estates.

A classification of the soils of the country has been prepared from our knowledge of the properties and behaviour of different soils; here field and laboratory work are closely related. Other laboratory investigations include the examination and review of methods of chemical analysis of soils, the use of leaf and tissue analysis for the diagnosis of nutritional requirements, and studies of phosphate and nitrogen status in the soil.

The Soils Chemist does not work in isolation and many of his problems involve workers in other Divisions. Thus the study of nutritional disorders by growing rubber in pots demands close cooperation with the Botanist and the Plant Physiologist. This technique eliminates many of the variable factors occurring in the field and approaches the accuracy and refinement of a carefully controlled laboratory experiment. Similar cooperation is required by the Soils Chemist with the Botanist when examining the effect of manures and tapping systems on yield, and with the Chemist when examining the effect of manures on chemical composition of latex.

Weed Control on Rubber Estates

CHEMICAL WEED CONTROL on rubber growing lands in Malaya is relatively undeveloped. Sodium arsenite and sodium chlorate were tested for killing lalang grass (*Imperata cylindrica*) in pre-war years by the Malayan Department of Agriculture, and an account was published by the Rubber Research Institute of Malaya in 1935 of the effects of several common chemicals on various weeds found on rubber estates. Little interest was shown in weedkillers, however, until rubber estates were reopened after the war in 1946, when the eradication of lalang, by methods other than the traditional one of hand digging, became a question of paramount importance.

LALANG CONTROL WITH ARSENICAL WEEDKILLERS

Owing to the lack of other sources of supply, old stocks of 'tin mine arsenic' were first used. These were residues of crude arsenic oxide accumulated from tin smelting processes. Later commercial sodium arsenite was the basis of the arsenical solutions which were successfully sprayed on lalang. The standard spraying procedure evolved from the first trials was to apply 15 lb sodium arsenite dissolved in 60 gallons of water to an acre of standing lalang, at each spraying. Up to ten rounds of spraying may be required, the number varying with the age and the vigour of the lalang, and intervals of nine to ten days are allowed between sprayings. In practice, a smaller total volume of spray liquid is sufficient for the later spraying rounds as the amount of regenerating lalang decreases. No pre-treatment is given to the lalang before spraying it because the original top growth, after being killed, forms an effective mat for smothering new shoots of the grass.

Sheet lalang in open situations and under young rubber trees has been effectively controlled by this poisoning technique. In the open, the lalang cannot be completely killed by spraying, and 'effective control' means that the lalang is reduced to a condition where an additional light digging (changkolling) or forking of any sporadic new growth is required to complete the eradication. Under the light shade formed by canopies of semi-mature rubber trees little, if any, lalang regenerates after the spraying has been completed.

Analysis of the grass roots after the grass has been sprayed shows that little or no translocation of arsenic occurs and confirms the view that sodium arsenite acts on lalang grass entirely as a contact herbicide.

The inclusion of spreading agents with aqueous weedkiller solutions is almost universal practice, and the addition of 0.05 per cent of a spreading agent with sodium arsenite sprays allows a reduction of concentration of sodium arsenite to 9lb or 6 lb per acre per spraying required for lalang grass.

The effectiveness of sodium arsenite as a general weedkiller has led to its widespread use in Malaya since the war, and recent imports into the Federation of Malaya have been at the rate of 6,000 tons per annum.

DANGER FROM ARSENICALS

There are several disadvantages in using sodium arsenite as a weedkiller, the most important of which are the danger to human beings and animals and the risk of damage to crops and the soil. Where rubber

trees are growing in the area being sprayed, contact of the arsenical spray on the bark may cause a light flaking or cracking of the outer bark or cortex, but at the worst may produce large open wounds and a destroyed tapping panel. With normal care when spraying, such serious damage is avoidable, though when young and small rubber plants are involved it has been found necessary to place screens of canvas or sacking around the plants whilst the application is being made.

When applied in sufficient quantity arsenic will act as a soil sterilant, but the total amounts applied to lalang in ten spraying rounds are well below the minimum quantities (320 lb to 1280 lb per acre) required for soil sterilisation in temperate regions. Damage to rubber trees by absorption from the soil has not been observed and would be expected to show readily as a foliage disorder. Rubber which has been replanted in an area after the completion of eight spraying rounds has exhibited no abnormalities of growth. Regeneration of other covers in areas from which lalang has been eradicated by spraying with sodium arsenite is not interfered with by any residual effects from the arsenic, and new plants appear within a month or two of cessation of spraying. Under Malayan conditions a very high degree of fixation of arsenic occurs with the average inland ferruginous soils, and laboratory tests in the Rubber Research Institute have shown that a negligible amount leaches through a column of soil. As a corollary to this, the appearance of arsenic in latex from trees in sprayed areas is not expected, although this has not been confirmed by chemical analysis as yet.

As a result of the high rate of rainfall in Malaya, sodium arsenite is diluted and washed from the soil. Where there is considerable 'run-off' water in sprayed areas, it may contain appreciable amounts of sodium arsenite, from which arises the danger of contamination of drinking water supplies (streams, wells, reservoirs *etc*). Special legislation has been enacted in Malaya which, by controlling the use of this poisonous chemical, is intended to reduce the hazards to human and to animal life. It deals particularly with the safeguarding of water supplies, the protection and safety of workers engaged in handling sodium arsenite, and the transport of the chemical and disposal of empty containers.

LALANG CONTROL WITH OTHER HERBICIDES

In spite of its effectiveness as an economical weedkiller, sodium arsenite has disadvantages, and considerable effort has been made to find a suitable substitute which is relatively non-poisonous and safe to handle, yet with the same killing effect and at the same cost as sodium arsenite. Over a wide range of tested substances the results have been disappointing, and below are mentioned only those with which a fairly good control of lalang has been obtained.

Oils and fortified oils — Much attention has been given in Malaya to oil sprays for killing weeds and although considerable success has been claimed in controlling lalang, the results seem to be difficult to reproduce.

Aromatic gas oil and the diesel fuel types have been used. The former contains a higher percentage of herbicidal aromatic compounds and is more expensive. Straight oils are similar in effect to standard sodium arsenite solutions, usually five or six spraying rounds being required, at

60 gallons per acre, and the regeneration of new shoots is rather slower than after arsenic spraying. The cost, however, is considerably higher. With straight oils, no appreciable or worthwhile differences could be found between the different qualities, and their effects were similar whether applied to standing lalang or lalang regenerating after slashing. The inclusion of small amounts of pentachlorphenol or of 2,4-D compounds gave no better results with lalang.

Sodium trichloracetate and ammonium sulfamate — Of the newer, postwar herbicides, sodium trichloracetate (Sodium TCA) and ammonium sulfamate (Ammate) have received extensive trial in the United States, the former for the specific control of annual and perennial grasses, and the latter as a general non-selective weedkiller. Both weedkillers are non-poisonous and relatively harmless, but are expensive and have to be used in high concentrations.

Standing lalang has been killed by applying sodium TCA (60%) at 435 lb per acre in a single application (10% aqueous solution). Ammate was not so effective. With more dilute solutions, three applications of sodium TCA were required at intervals of five weeks, each at 90 lb per acre (90%), to give effective control; 42 lb and 12 lb per acre per spraying were ineffective. Again, Ammate applied at the same rates was less effective than sodium TCA.

The inclusion of the sodium salt of 2,4-D (40% acid equivalent) at the rate of 6 lb per acre per spraying, with 90 lb TCA, showed that quite good control of lalang could be obtained with two sprayings at a ten week interval. Ammate was not so effective. Further observations in this trial were curtailed by accidental fire.

In one area, on sandy soil, standing lalang of moderately vigorous growth was completely destroyed with a single spraying of sodium TCA, 60 lb per acre being applied in water (about 100 gallons). This and other observations have indicated that the effectiveness of a spraying treatment may depend on the quality, age, vigour and toughness of the weed that is being sprayed, and sometimes on the physical condition of the soil. Light soils favour penetration of the weedkiller, and sodium TCA can be very effective if it has direct contact with the root system. The 'quality' of the lalang is variable, and frequently cannot be assessed because of lack of information on its age and on the number of times it has been burned down by accidental fires. Hence, little can be done to allow for 'quality' when considering spraying results.

It should be noted that sodium TCA requires care in handling, and contact with the bare skin will cause blistering. It should not be left overnight in spraying equipment, because it may decompose, giving an acid residue which will corrode spraying machines.

Oil emulsions and fortified emulsions — It was an obvious step, in the light of experience in other countries, to investigate the action of oil/water emulsions on lalang, and to ascertain whether synergistic effects might be obtained by including other herbicides in the oil and water phases of the emulsion. Considerable difficulty was experienced in preparing stable emulsions, and trials with laboratory preparations and commercial emulsifiable concentrates, containing pentachlorphenol, 2,4-D compounds, and dinitro orthocresol (DNOC) derivatives gave no outoutstanding successes.

Figure 1. Rubber planted after lalang has been eradicated by spraying with sodium arsenite.

Figure 2. Lalang eradicated by spraying with sodium arsenite in an area already planted with rubber.

Figure 3. Lalang sprayed out with sodium arsenite under semi-mature rubber.

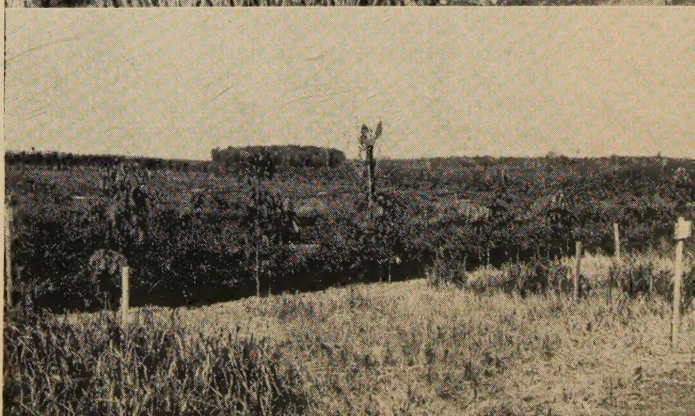


Figure 4. Lalang in the open killed by an oil emulsion spray.

More recently a procedure has been developed based on laboratory tests and small plot trials, which appears to give a successful kill of lalang after two sprayings and a third round of 'spot' spraying. Intervals of one to two weeks between sprayings were allowed. The emulsion is easily prepared in the field by unskilled labour, and has sufficient stability to allow its use for bucket pump spraying. Diesel fuel is used and an emulsion (15% oil in water) is prepared using ammonium oleate. The fortifying chemicals are sodium trichloracetate (2%) and sodium pentachlorphenate (1%) and spraying was done at the rate of 100 gallons per acre on lalang which was freshly regenerating after slashing. This procedure resulted in control of lalang which was more effective than with sodium arsenite spraying, requiring only three rounds as against a possible ten rounds with arsenic. The chemicals are non-poisonous and require only reasonable care in handling. Although the materials used are

Figure 5. Siam weed controlled by spraying with sodium arsenite.

expensive, in comparison with sodium arsenite, the final cost is slightly above the present cost of spraying (for ten rounds) with arsenic, and is below $200 per acre.

The extension of this treatment to a large area (30 acres) of lalang, which was first burned and allowed to regenerate, and the employment of a Chinese contractor to do the work revealed that a much larger volume of spraying liquid was required in commercial spraying for adequate coverage, 170/180 gallons per acre being used. The spraying was not so successful as when slashed lalang is sprayed and two rounds of chipping were required after spraying was completed to bring the area on to normal monthly weeding, the total cost of the treatment by then being close to that for three rounds of hand digging.

N-p-chlorphenyl N',N'-dimethyl urea — This chemical, known as CMU for short, has recently been extensively tested in Canada and the United States for killing grasses on rail road beds, oil refinery yards and manufacturing plant sites. Preliminary tests on lalang in Malaya have shown it to be highly effective when applied at the maximum recommended rate of 80 lb per acre, no regeneration of lalang having occurred in three months after one application. CMU is only available in very small amounts at a cost of $12.40 (Malayan) per lb in this country, and any extension of its use at this price appears unlikely.

CHEMICAL CONTROL OF WEEDS OTHER THAN LALANG

The more general problem of substituting routine monthly hand weeding on rubber estates by the use of machine sprayed chemical weedkillers has not received much attention, and there appear to be possibilities for developing such methods in young rubber areas. Efficient control of weed competition during the early growth of rubber plants is essential for their normal development. Hand labour, using the changkol as a soil scraper, is still widely used by estates for cleaning the strips along planting rows and contour terraces. Chemical spraying of the weeds which invade these clean strips offers the advantages of elimination of soil erosion following soil loosening caused by digging and scraping, reduced labour requirements and possibly cheaper costs.

The method of spraying must be such that the young rubber plants are not damaged, either by direct contact with the spray or by the chemical acting in the soil on the roots, and also that only the immediately competing section of the cover is treated. Light, easily movable screens may have to be used for protection of the rubber plants during the spraying operation. Although 'low volume' spraying would effect economies in carrying and in water usage, the drift of the very fine spray on to young rubber plants, which could not be prevented by screening, would cause considerable damage. For this reason, and because the extent to which the covers are to be treated can be better controlled, high volume spraying has been used for general weeds in young rubber areas. Although in a few instances power operated spraying from a multi-nozzled boom may be possible, difficulties of terrain, contour terraces on hill slopes, cross drains and ditches in flat land, felled timber and old jungle tree stumps restrict spraying equipment to the simple knapsack and bucket pump types.

If mechanised operations are to be possible on all types of rubber growing land then estates must be planned and planted with this end in view. Wide spacing between planting rows must be adopted along which special contour tracks for machines can be prepared. Until these are general, mechanised spraying will be restricted to a few special areas which happen to be suitable.

The small amount of information at present available on the response of different covers to weedkillers may be summarised as follows:

Grasses — The weeding problem on many estates is centred on the control of grasses, of which there are many varieties. Because of their hardiness they survive where softer broad leaved plants are more readily controlled by changkol scraping or by chemical weedkillers. Straight oil sprays and sodium arsenite solutions give partial control of grasses but the scorching effect is only temporary. Fortified emulsions, of the type mentioned earlier in these notes, give better results but as yet cannot be recommended for routine estate practice.

Broad leaved bushes — In general, these plants are susceptible to 2,4,5-trichlorophenoxyacetic acid compounds; Siam weed (*Eupatorium odoratum*) has been killed by spraying with 0.1% solution of the sodium

salt of this acid. Bracken or resam (*Gleichania linearis*) has been effectively killed by spraying with a 5% solution of the sodium salt of 2,4-dichlorophenoxyacetic acid (Fernoxone) and also by 1% sodium arsenite, two sprayings being required with the latter. Straits rhododendron (*Melastoma polyanthum*) when sprayed with sodium arsenite or sodium trichloracetate is usually only defoliated. Stagmoss (*Lycopodium cernuum*) has been killed by spraying with sodium arsenite at 1% strength.

Creeping plants, ferns — Water hyacinth (*Eichornia crassipes*) and *Mikania scandens* have been killed by spraying with the sodium salt of 2,4-dichlorophenoxyacetic acid (Fernoxone) dissolved in water, using 10 lb per acre for water hyacinth and 2 lb per acre for *Mikania.*

Mimosa pudica can be killed when treated with 2-methyl, 4-chlorophenoxyacetic acid (Agroxone), using 6 pints in 100 gallons water per acre.

The fern, *Nephrolepis biserrata,* was severely scorched but not killed when sprayed with sodium trichloracetate at 10% strength in water; with ammonium sulfamate (Ammate) at the same strength a better killing effect was obtained.

CONCLUSION

Certain of the newer herbicides have been tested to varying degrees in Malaya. Very little work has been done with some, such as isopropyl phenylcarbamate, dinitro-o-cresol, and pentachlorphenol. More detailed comparisons are required between the various derivatives (*e g* amines and esters) of both 2,4-dichlorophenoxyacetic acid and 2,4,5-trichlorophenoxyacetic acid. There are a number of compounds which have not been used at all, such as sodium isopropyl xanthate, sodium 2,4-dichlorphenoxy ethyl sulphate, *etc.* Methods of formulation require investigation, in particular the mixing of weedkillers and synergistic effects. In this connection, much more needs to be known about the mechanism of the 'killing' of the weed. Excessive concentrations of a contact herbicide may produce a rapid destruction of the green aerial portions of the plant, and if used with a hormone weedkiller, which requires to be translocated, the latter may be rendered ineffective by the unduly rapid destruction of the plant tissues. Continued use of a selective weedkiller may result in the establishment of a resistant plant species, which in turn will become a weed problem. It is not beyond the bounds of possibility that an immunity to one type of herbicide may be built up in the plant, and thus a rotation of weedkillers may become necessary. The use of 'pre-emergence' weedkillers is an attractive prospect which requires investigation for closely planted nurseries and for newly planted clearings. Finally, there is always room for refinement in determining the optimum quantities to use, the best time to apply weedkillers and the most economic method of application.

It should be clear from the preceding remarks that little more than the fringe of problems relating to chemical weed control has been penetrated in Malaya. The work that has been done, however, holds every promise for a great extension of the use of herbicides in the future.

SOILS DIVISION

Manuring of Young Rubber Plants

IN DISCUSSIONS ON FERTILISER APPLICATIONS to rubber areas, emphasis is often given to the need for 'maintaining a correct balance of nutrients.' We fully agree with the principle of maintaining such a balance, but it is nonsense to claim because the plant uses the three main nutrients, that all three *must* be added together whenever a fertiliser is applied. If the soil already contains an abundance of one of these nutrients then the proper way to maintain the correct balance is to add the other two in the form of fertilisers.

It is generally agreed that young rubber growing on inland soils in Malaya responds to treatment with phosphate. A recommendation to use nitrogen is equally acceptable because we know that adequate supplies of readily available nitrogen are necessary for normal plant development and, since this nutrient is easily leached out of the soil, it is reasonable to add more periodically in order to make up the losses. We also know that nutrients other than nitrogen and phosphate are essential for the growth of plants. Certain elements such as manganese, copper, molybdenum, boron, sulphur *etc* are required in very small quantities, and they are called minor nutrient elements or trace elements. They are not normally added purposely to fertilisers applied in rubber areas in Malaya, because we have not the evidence to show that the small quantities which must be present in all soils are inadequate for normal development of the rubber plant.

POTASH REQUIREMENTS OF YOUNG RUBBER PLANTS

Potassium is another important nutrient element. Like nitrogen and phosphorus, it is one of the essential major plant nutrients, and indeed we have found that, along with nitrogen and phosphate, it must be added to very sandy soils in Malaya if the optimum response by the rubber trees to fertilisers is to be produced. However, experimental results obtained so far have shown that while rubber plants growing on very sandy soils may benefit from added potash, they seldom show any response when they grow on the loams and clay loams which cover very much more extensive areas in this country. This evidence is quite reliable because the experiments, from which the results referred to have been obtained, are sited on a variety of soil types in all parts of the country. The conclusion is, therefore, that reserves of potash already present in the majority of Malayan soils are adequate for normal growth of rubber, and are formed as a result of the weathering of potassium minerals in the soils.

If rubber plants seldom show any response to additions of potash when they grow on most inland soil types of average texture, *i e* the loams and clay loams, it may be asked why do we recommend a complete fertiliser for the first two years after planting in replanted areas, and almost invariably in nursery areas? The answer is that the recommendation is largely a precautionary measure, and in nine cases out of ten the potash included in the mixture may have no effect but in the tenth case it may be beneficial. Although the majority of Malayan soils appear to have adequate reserves of potash for normal growth of rubber we have to remember that there may be several areas where, for some reason or other, the supply of native potash is not sufficient. One cannot

always tell by the visual examination of the soil whether it is or is not deficient in potash, and the recommendation to apply a complete fertiliser to the young plants is a general one for all inland soils and not only for those in which the supply of native potash is at or just below the threshold value.

During the early stages of growth of the rubber seedling its root system exploits only a limited volume of soil. There is a greater risk at this stage of the developing roots running into a pocket of soil where the required nutrients are deficient, than at a later stage when the root system has penetrated a much larger volume of soil. Therefore it seems to be a wise precaution to use a complete fertiliser for the initial applications and thus ensure that all three nutrients are present in adequate amounts and in readily available forms during the early stages of growth of the plant. The use of a complete fertiliser instead of a nitrogen and phosphate mixture (which according to the evidence available could be used in most areas) is thus a form of insurance against the possibility of the content of soil potash being inadequate for early exploitation by the plant. The extra cost of the small quantities of potash required for these initial applications is a very small premium to pay for ensuring the early development of healthy plants in all parts of a replanted area. The potash may be superfluous in many instances but it is better to err by being too generous than too sparing.

NURSERY MANURING

The manuring problem is rather different in nursery areas. Here we have what might be called intensive cultivation, with the number of plants per unit area increased twenty times or more, and the chances of exhausting the nutrient supplies of the soil are very much greater. The potash content of a given soil may be sufficient for a normal field planting of two hundred plants per acre but may be quite inadequate in the same area for a stand of five to ten thousand nursery plants. A further consideration is the effect of a large supply of one nutrient in the soil on the absorption by plants of another nutrient present in much smaller quantities. Excessive amounts of one plant food may induce deficient absorption by the plant of another plant food, and it is known that phosphate and potash can interact in this way. Phosphate is one of the nutrients normally applied regularly in nursery areas and, with the total amount of added phosphate becoming quite appreciable over a period, the uptake of potash may easily be seriously reduced.

EXAMPLES OF FOLIAGE ABNORMALITIES IN NURSERIES

Interesting illustrations of this effect were recently obtained from the examination of two nurseries in which rubber seedlings showed foliage abnormalities. In one nursery, in irregularly shaped patches, the young rubber plants were stunted and the colour of the leaves was abnormal. They symptoms observed were described thus: 'Chlorotic leaves distributed irregularly throughout the nursery area. Chlorotic plants much smaller than the surrounding healthy plants. The colour pattern on the leaves was irregular, but marginal yellowing was dominant with intervenal spreading of chlorotic tissue towards the midrib weakly deve-

loped. Division between green and chlorotic tissue not sharp and distinct. Necrotic spots or splotches abundant.' Compare this description with that of symptoms observed in a second nursery area not very far away from the first; 'Chlorosis of the leaves of buddings fairly uniform throughout the area. Plants generally well grown and there appeared to be no correlation between growth and intensity of chlorosis. Colour pattern fairly regular; marked intervenal chlorosis with green tissue along the veins showing up fairly distinctly. Leaves of several whorls of each plant showed marked chlorosis. Necrotic spots or splotches abundant.'

Figure 1. Pocket application of fertiliser to young rubber.

Here we have two nurseries where evidence of nutritional disturbance in the plants showed up clearly, but obviously the factors responsible for the disturbances were not identical in both nurseries. In both areas nitrogenous and phosphatic fertilisers had been applied regularly.

Samples of leaves from healthy plants and from plants showing the chlorotic condition were obtained, and samples of soils from the same areas were also collected.

The results of leaf analysis showed abnormally low values for the potash content of the leaves of chlorotic and stunted plants in the first nursery, and the potash in the different leaf whorls fell rapidly from the top whorl downwards. Smaller potash values for the bottom leaf whorls, compared with the upper whorls, may be expected even in healthy plants, but here the values for all leaf whorls were abnormally low and the difference between the potash content of the top whorl and the

Figure 2. Surface application of fertiliser to young rubber.

second whorl of leaves was very marked. It was quite evident that the plants were suffering from an acute deficiency of potash. The phosphorus and calcium contents of the leaves were normal but the magnesium content was rather low. The diagnosis based on the results of leaf analysis was that the principal cause of the backward growth and the chlorotic condition of the plants in this first nursery was potash deficiency, and deficiency of magnesium was possibly a contributory factor.

The analysis of the leaves obtained from the second nursery area gave quite a different picture. Here the values for the potash content of the leaves were normal, although some samples showed a slight decrease in values for the lower leaf whorls, indicating that effects of a mild deficiency of potash might be developing. The phosphorus and calcium contents again were normal, but the magnesium content of these leaves was very low. Magnesium values were consistently lower than those for the leaves of plants in the first nursery and there was a marked fall in values from the top whorl down to the basal whorl. There is no doubt that the principal cause of the chlorotic appearance of the leaves of plants in this second nursery was magnesium deficiency.

The development of symptoms of acute deficiency of potash in the first nursery was unexpected. The soil is a type which, on visual inspection, one would not normally classify as a potash deficient soil. Young replanted rubber plants in the area surrounding this nursery appeared quite normal, and the symptoms of nutritional disturbance which were apparent in the closely planted nursery were not observed in the adjoining area carrying a normal stand of rubber replanted in the usual way. The conclusion is that the potash content of this particular soil is adequate for normal development of rubber plants planted at a density commonly accepted for replanted areas but may be inadequate for a much higher planting density as in a nursery.

An analysis of soil samples obtained from this nursery gave results which threw some light on the problem. The potash content of the soil was indeed rather low, at least it was lower than we expected, but since the values for soils from good and poor parts of the nursery were approximately the same the foliage abnormalities which were apparent in parts of the nursery could not be accounted for entirely on the grounds that the potash reserves in the soil were insufficient for normal development of the rubber plants. The potash value is probably close to, but not below, the threshold value since growth and colour of leaves were perfectly normal in other parts of the nursery. The nitrogen content of the soil was also rather low but again there was no difference between the values for the soils from the good and the poor parts. The phosphate content on the other hand was very high for all samples and particularly high in the samples obtained from the parts where the plants were stunted and where the leaves were yellow. The phosphate content of the soil from the poor section was twice as high as that from the good section.

Herein lies the explanation of the nutritional disturbances causing the symptoms which we have described. Acute deficiency of potash in the plant has been induced by the very high phosphate content of the soil. It is to be noted that several dressings of nitrogen and phosphate were applied in this nursery and where growth appeared to be backward more was applied thus aggravating the condition. The nitrogen is easily leached out of the surface soil but the phosphate is held firmly and the

content per unit volume of surface soil increases with each application Excess absorption of phosphate has resulted in a restricted absorption of potash. We know that this can happen, and it may happen when reserves of soil potash are limited or close to the threshold value as in this area. Where potash supplies are abundant it is unlikely that excessive applications of phosphate will produce the same effect. Here the balance was easily upset but it is probable that very little potash is required to restore the balance.

CONCLUSIONS

Several facts of practical interest emerge from this investigation into the causes of abnormalities in the two nurseries:

1 Yellowing of rubber leaves may be due to one of several causes. Among these may be included magnesium deficiency and potash deficiency. Symptoms of the former (which occur most frequently in Prang Besar planting material) can be distinguished from those of the latter if the colour pattern on the leaf blade is carefully examined.

2 It is a wise precaution to mix magnesium lime (or any other suitable magnesium compound) with the soil in a nursery, especially if the nursery is to be planted with Prang Besar planting material.

3 Although the potash content of most Malayan soil types would seem to be adequate for normal development of the rubber plant, symptoms of potash deficiency can be induced by frequent application of phosphate during the early stages of growth, that is, while the root system is exploiting only a limited volume of soil. This applies more particularly to plants in nursery areas.

4 It naturally follows from *3* above that it is advisable to use a complete fertiliser rather than a nitrogen and phosphate mixture for manuring in nursery areas. This applies also, but to a lesser extent, when applying fertilisers during the early stages of growth in a replanted area. If potash is not included in the mixture in a replanted area the risk of nutritional disturbance is probably small in most areas, but there is a risk nevertheless, and the cost of the small quantity of potash required to be added during the first two or three years of growth is a small premium to pay for avoiding that risk.

5 Potash deficiency may cause chlorosis of the leaves, but what is more important it has a marked retarding effect on growth. Judging from observations in the second nursery examined it would appear that magnesium deficiency on the other hand is not necessarily associated with a marked retarding effect on growth, even though a chlorotic condition of the leaves caused by magnesium deficiency may be readily apparent.

This last observation requires confirmation, but the limited amount of evidence available so far suggests that presence or absence of adequate quantities of magnesium in the soil may not have an appreciable effect on growth of young rubber plants.

SOIL DIVISION

Seed Gardens for Estates

AT THE PRESENT TIME the demand for clonal seed greatly exceeds the supply. It is likely that with the extensive replanting which is being carried out on the majority of rubber holdings this demand will continue. This article offers recommendations for the layout of simple and practicable seed gardens suitable for estates or for the larger smallholdings. It is not intended to imply that our recommendations for planting* are restricted to the material quoted, nor even solely to clonal seedlings, but seed obtained from budded stands as described here may be accepted as being of good quality and may be confidently planted.

To prepare a standard design of a suitable seed garden the following points must be carefully considered:

1. The clones in the seed garden must be good seeders, and must produce good seedling families. If, as in smallholdings, the seed garden is a large proportion of the property, the clones should also be good yielders.
2. Budwood of the clones involved should be easily obtainable.
3. The planting density should preferably be that in normal use on estates.
4. Adequate provision must be made against contamination occurring in the garden by pollen from extraneous rubber.
5. The design must be simple and easily laid out.

THE CLONES

The clones in the gardens should preferably be high yielders and must be good seeders, producing good families of seed.

Clone Tjirandji 1 — This clone is recommended by the R.R.I. for large scale planting. It is a good average yielder, and seeds well, producing both selfs and crosses of high value. Tj. 1 illegitimate seed is also recommended by the R.R.I. for large scale planting. Tj. 1 crossed with R.R.I. 501 has been found to be good in yield and secondary characters in the R.R.I. seedling trials. In Indonesia the cross Tj. 1 × Pr. 107 is considered of good value.

Clone R.R.I. 501 — This clone is recommended by the R.R.I. for large scale planting. It is a good yielder and a good seeder. Provided it is not crossed with related clones (for example, Lun. N or R.R.I. 509) it produces families of high yielding seedlings, especially when crossed with clone Tj. 1.

Clone Pr. 107 (Synonym: L.C.B. 510) — From the available evidence clone Pr. 107 appears to yield rather better than clone Tj. 1 in Malaya. It is also a prolific seeder, and is reported in Indonesia and Indo China to produce seedling families of good value.

Clone R.R.I. 526 — This is recommended for small scale planting and has given some good crosses with clone Tj. 1. It seems to be worth employing in a seed garden.

Clone Avros. 157 — This clone gives seedlings of good value with a low incidence of brown bast, especially when crossed with Tj. 1. Its selfed seed also appears to be of fair value. The clone is, however, a poor average yielder.

* *Choice of Clones and Clonal Seedlings: Planting recommendations for 1952-53. Circular No. 37*

BUDWOOD

All the clones recommended above except the R.R.I. clones are 'free'. Their budwood may be obtained without restriction but it should come from a reliable source. The R.R.I. clones are obtainable from the Manager, R.R.I. Experiment Station, Sungei Buloh, Selangor.

COMPOSITION OF SEED GARDEN

The most promising combination of clones appears to be Tj. 1 × R.R.I. 501 × Pr. 107. For seed of better value Avros. 157 may be added, or substituted for Pr. 107. R.R.I. 526 could also be added if desired.

Note — Clones P.B. 86, Pil.B. 84, Lun. N, P.B. 24: These clones are not considered suitable for this specific purpose because of either low yield (P.B. 24, Lun. N), or poor seedling families (P.B. 86, P.B. 24), or because of shy seeding (Pil.B. 84, Lun. N).

PLANTING DISTANCE AND DENSITY

Crown development is essential if a good crop of seed is to be obtained. The seed garden should therefore be planted at a normal density preferably in some form of avenue planting, say 30 ft × 8 ft. If this is not possible, nor desirable, 22 ft × 11 ft can be employed. For either, thinning should be drastic, to leave a stand of about 100 trees per acre in the sixth year of life.

ARRANGING THE CLONES

It is recommended that 3 or 4 consecutive points per row be budded with each clone by turn. If on an avenue system of, say, 30 feet between rows it will be practicable to bud single avenues thus, since competition between rows will not be apparent till the trees are nearly mature.

If the planting is on closer spaced rows, for example, at 22 feet, it is advisable to bud the rows by pairs so that weaker clones may not be too suppressed during their early life by competition from vigorous neighbours.

Example: Three clones A, B and C

Avenue Planting	*Rectangular Planting*
* *	* *
† AAAABBBBCCCCA *etc*...	† A A A B B B C C C A *etc* ...
	A A A B B B C C C A *etc* ...
BBBBCCCCAAAAB *etc*...	
	B B B C C C A A A B *etc* ...
CCCCAAAABBBBC *etc*...	B B B C C C A A A B *etc* ...
	C C C A A A B B B C *etc* ...
† A *etc*.....	
	C C C A A A B B B C *etc* ...
etc	† A *etc* .....
	etc

* *Pattern of clones along row repeats at asterisk*

† *Pattern of rows repeats at dagger*

Should a four or a five clone seed garden be desired—and there is no genetical reason why more clones than three should not be used in a seed garden—the following plans give the maximum opportunity for crossing.

Example: Four clones A, B, C, and D

	*				*	
†	A	B	C	D	A	*etc* ...
	C	D	A	B	C	*etc* ...
	A	B	C	D	A	*etc* ...
	C	D	A	B	C	*etc* ...
†	A	B	C	D	A	*etc* ...
	etc.....					

Example: Five clones A, B, C, D and E

	*					*	
†	A	B	C	D	E	A	*etc* ...
	C	D	E	A	B	C	*etc* ...
	E	A	B	C	D	E	*etc* ...
	B	C	D	E	A	B	*etc* ...
	D	E	A	B	C	D	*etc* ...
†	A	B	C	D	E	A	*etc* ...
	etc.....						

In the examples above for four clone and five clone gardens each letter represents a group of 3 or 4 trees of each clone, per single row if planted as an avenue, or per two rows if planted on a rectangular system in the same way as was described for a three clone garden.

To set up seed gardens in this manner calls for careful supervision at the time of establishment. It is suggested that before budding is commenced, coloured distinguishing paint, one colour for each clone, be put on the stock plants to facilitate correct budding. If the paint is put on at the base it will remain after cutting back as a record of clone identity till the scion shoots have grown large enough to be marked. The preliminary marking should however be carried out at least one month before budding as fresh paint may hinder satisfactory stripping of the bark of the stocks.

Example: Three clones A, B and C

Avenue Planting	*Rectangular Planting*
† AAAAAAAAA ...	† A A A A A A A A A ...
	A A A A A A A A A ...
BBBBBBBBB ...	
	B B B B B B B B B ...
CCCCCCCCC ...	B B B B B B B B B ...
	C C C C C C C C C ...
† AAAAAAAAA ...	
	C C C C C C C C C ...
etc	† A A A A A A A A A ...
	etc .....

One other system remains which is not quite as effective in bringing about cross pollination, but which simplifies both the layout of the garden and also the task of measuring the yield of the clones if this is desired. This is to bud one complete avenue, or two complete rows with the clones across the length of the seed garden, as shown at the foot of the previous page.

For a three clone garden budded in complete rows there is no advantage in changing the order of the clones since, by a straightforward repetition of the order, each clone comes next to either of the other two. If, however, four or five clones are to be budded thus, the necessity for changing their order is apparent, since by not doing so each one of the clones would never be neighour to one or two other clones in the seed garden. The chance of crossing between these would thus be greatly reduced.

A suggested order of budding for the 4-clone and the 5-clone gardens is:

Example: Four clones A, B, C and D

† A A A A A .....
B B B B B .....
C C C C C .....
D D D D D .....
A A A A A .....
C C C C C .....
D D D D D .....
B B B B B .....
A A A A A .....
C C C C C .....
B B B B B .....
D D D D D .....
† A A A A A .....
etc .....

Example: Five clones A, B, C, D and E

† A A A A A .....
B B B B B .....
C C C C C .....
D D D D D .....
E E E E E .....
B B B B B .....
D D D D D .....
A A A A A .....
C C C C C .....
E E E E E .....
† A A A A A .....
etc .....

In these two examples, as in the previous examples for four clone and five clone gardens, each letter represents one clone in one avenue row or one clone in pairs of rectangular planted rows.

For the four clone seed garden the unit is 12 rows or pairs of rows with 3 replications of each clone, plus one row of clone A. For the five clone seed garden it is 10 rows or pairs of rows with 2 replications per clone plus one row of clone A. These may be repeated indefinitely within the space available and should for preference be complete since a broken unit reduces the chances of some of the crosses occurring.

This calculation, takes no account of relative interclonal fertility nor of relative seed production but merely gives an equal chance to all the possible crosses to occur.

As it is necessary to start and to complete the unit with clone A, this clone should be the one used for the boundary belt (see below). The first and the last rows of the central seed garden may then be the innermost row of the boundary belt.

PROVISION AGAINST CONTAMINATION FROM SURROUNDING RUBBER

If other rubber exists within 5 chains of the seed garden it will be necessary to provide a boundary belt 5 chains in depth. It is recommended that this belt be budded with one of the clones in the seed garden, and where clone Tj. 1 is used, the boundary belt should always be of this clone.

In such conditions three classes of seed can be collected:

1 From the seed garden, consisting of the desired crosses and selfs of the clones in it.

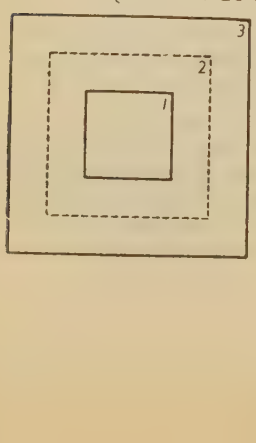
2 From the inner $2\frac{1}{2}$ chains of the boundary belt. This seed would consist of selfs of the clone in the boundary belt, and of crosses mainly with the clones in the seed garden.

3 From the outer $2\frac{1}{2}$ chains of the boundary belt. This seed would consist of selfs of the clone in the boundary belt, and of crosses mainly with rubber outside the seed garden.

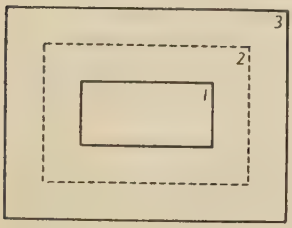
Seed from *1* should be of good value for planting. Seed from *2* should be of fair to good value for planting more especially if clone Tj. 1 is used. Some contamination may occur however. Seed from *3* cannot be recommended for planting as seedling trees but could be usefully employed as stocks for budding.

EXAMPLES OF SEED GARDENS

The layout of various sizes of seed gardens are given below. Each is enclosed within a five chain isolation belt, and the areas yielding the three classes of seeds described above are quoted.

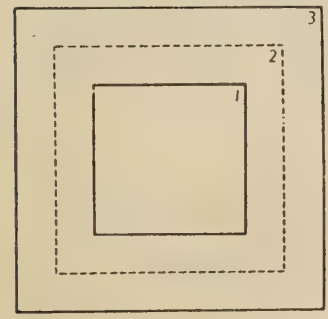
	DISTRIBUTION OF AREA WITH PROPORTION OF EACH SECTION TO THE WHOLE		
	Central garden	*Inner boundary*	*Outer boundary*
Class of seed:	*1*	*2*	*3*
(1) SQUARE 25.6 acres (16 ch × 16 ch)			
	3.6 ac (6 ch × 6 ch)	8.5 ac	3.5 ac
	14%	33%	53%

(2) RECTANGULAR
25.6 acres
(14 ch × 18.30 ch)



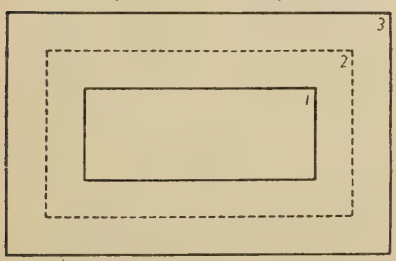
3.3 ac 8.6 ac 13.7 ac
(4 ch × 8 ch)
13% 33% 54%

(3) SQUARE
40 acres
(20 ch × 20 ch)



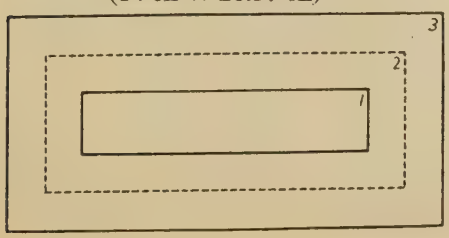
10.0 ac 12.5 ac 17.5 ac
(10 ch × 10 ch)
25% 31% 44%

(4) RECTANGULAR
40 acres
(16 ch × 25 ch)



9.0 ac 13.0 ac 18.0 ac
(6 ch × 15 ch)
23% 32% 45%

(5) RECTANGULAR (oblong)
40 acres
(14 ch × 28.57 ch)



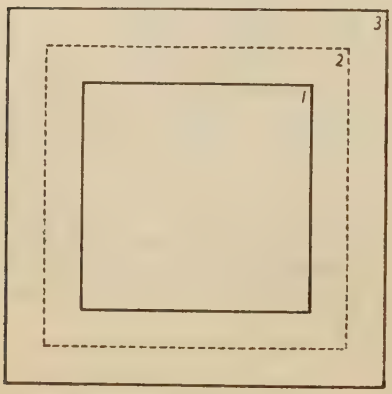
7.4 ac 13.8 ac 18.8 ac
(4 ch × 18.6 ch)
19% 34% 47%

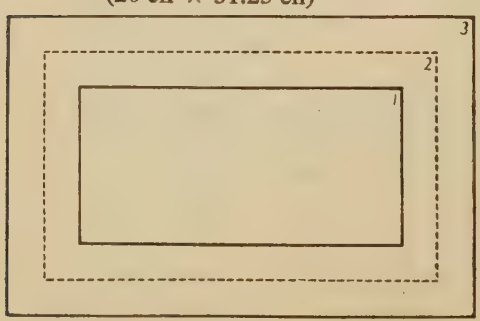
It is obvious from the above that the more economical layout for a seed garden is on a square plan, and the further removed a layout becomes from a square shape the smaller the central area is in proportion to the whole. Under conditions of planting demanding an isolation belt the minimum size of an area for a practicable seed garden would seem to be about 20 acres or, say, 14 chains by 14 chains square. This would permit a central garden of 1.6 acres to be established. A garden smaller than this appears hardly worthwhile.

The calculation made above, that a square shape allows a better use of the land in establishing small seed gardens, remains equally true for larger seed gardens, although the advantage of a square shape becomes less as the size of the area increases. The relative proportion of the acreage of the central garden to the whole also becomes larger with increase in size.

DISTRIBUTION OF AREA WITH PROPORTION OF EACH SECTION TO THE WHOLE

Class of seed:	*Central garden* 1	*Inner boundary* 2	*Outer boundary* 3
(6) SQUARE 62.5 acres (25 ch × 25 ch)	22.5 ac (15 ch × 15 ch)	17.5 ac	22.5 ac
	36%	28%	36%
(7) RECTANGULAR 62.5 acres (20 ch × 31.25 ch)	21.3 ac (10 ch × 21.15 ch)	18.1 ac	23.1 ac
	34%	29%	37%





ROUGH ESTIMATE OF PRODUCTION

If a stand of 100 trees to the acre is considered, and an annual production of 50 pods per tree (150 seeds) be taken as average, the following returns might be expected in normal seeding years:

Example of garden	*1* Seed	%	*2* Seed	%	*3* Seed	%	*Total Crop*
1	54,000	14	127,500	33	202,500	53	384,000
2	49,500	13	129,000	33	205,500	54	384,000
3	150,000	25	187,500	31	262,500	44	600,000
4	135,000	23	195,000	32	270,000	45	600,000
5	111,000	19	207,000	34	282,000	47	600,000
6	337,500	36	262,500	28	337,500	36	937,500
7	319,500	34	271,500	29	346,500	37	937,500

As the area of the seed garden increases the proportion of seed of class *1* that can be collected increases.

Reprints of this article may be obtaned on request.

BOTANICAL DIVISION

Leaf Sampling for Diagnosis of Nutrient Deficiency

ABNORMAL DEVELOPMENT OF PLANTS due to adverse growing conditions may take many forms, the most common of which is leaf discolouration. It frequently happens that leaves of rubber plants showing abnormal colour are sent to us for diagnosis. When the disorder is caused by pests or disease, samples showing typical symptoms of that disorder are usually all that is requuired. An article on the *Despatch ot Pathological Specimens to the R.R.I.* appeared in our last issue (P.B. 3, page 69) and should be referred to for this purpose. But the most common cause of leaf discolouration is some form of nutritional disorder; either a particular nutrient is present in excessive amounts, causing injury to the leaf, or the plant may be showing the effect of a serious deficiency of one or more of the several nutrient elements it requires for normal growth. In a few instances, it happens that the symptoms of a nutritional disorder are characteristic enough to be recognised with some certainty by visual inspection, but usually we prefer to base our diagnosis on the results of chemical analysis of the leaves.

When plant analysis is required for diagnostic purposes it is not sufficient to send only a specimen exhibiting symptoms of the disorder. We also require samples from healthy plants in the same area for comparison and furthermore the sampling of both healthy and affected plants should be done in a certain way. Instructions for taking leaf samples in rubber areas where the discolouration of the foliage is suspected to be due to nutritional disorder are given below.

METHOD OF LEAF SAMPLING

Samples are required from (*a*) normal plants and (*b*) affected plants in the same field or the same nursery. The normal and affected plants must be of the same age and from the same clonal block.

A. *Sampling of leaves from young unbranched rubber plants* — Select six normal plants and six affected plants, all without new flush growth at the top. The uppermost whorl of leaves should be fully mature.

Remove two triplets of leaves (including leaf stem) from the top, second and third whorls of leaves. Keep the leaves from the different whorls separate, but combine the leaves from the corresponding whorls so as to give three bulk samples from normal plants and three from affected plants *i e* top, second and third whorls, each.

Sometimes the leaf discolouration appears only in the fourth or fifth whorl. Then leaves from the fourth and fifth whorls may also be sampled.

B. *Sampling of leaves from branched trees* — Select six normal trees and six affected trees. From each of these, select a branch which has no new flush growth at the top. Remove two triplets of leaves (including leaf stem) from the uppermost whorl on the branch. The leaves of this whorl must be fully mature. Combine the leaves from the normal trees to form one sample, and those from the affected trees to form a second sample.

All samples should be clearly labelled, placed between sheets of damp blotting paper and despatched to the Institute by the quickest route. Avoid sending samples at the weekend.

Reprints of this article may be obtained on request.

SOILS DIVISION

Control of Root Disease in Young Rubber

ROOT DISEASE CONTROL in young rubber areas should consist of periodic rounds of tree to tree collar inspection and treatment, combined with the removal of all detected sources of infection, whether they consist of root fragments or of old rubber or jungle stumps. If all such sources of infection are properly removed, it should be possible to eradicate root disease completely well before the stand is ten years old. The regular inspection of the rubber trees enables this process to be carried out without serious loss of stand.

FREQUENCY OF INSPECTION

The frequency of inspection depends on the severity of the attack. If the incidence is not particularly high, annual rounds of treatment should suffice, but where a heavy outbreak is encountered it would be advisable to carry out two rounds of treatment a year, at least during the second, third and fourth years. Provided the previous work has been thorough, there should be no need to continue tree to tree inspection beyond the fifth year, for by that time the position and extent of any persistent foci of infection will have been fairly well established,

and future inspection can therefore be confined to the neighbourhood of these known disease patches.

METHOD OF INSPECTION

Inspection consists in digging the soil away from the collar of the tree in order to expose a certain length of the tap root and a short section of each lateral root at its junction with the bole. Digging should be carried out with pointed hardwood sticks to minimise damage to the root system.

The success of the method depends on the fact that the root disease parasites are propagated by means of rhizomorph systems, which spread ahead over healthy roots, and thus enable the presence of the parasites to be detected in advance of root penetration. The method is most efficient in the case of *Fomes lignosus,* the rhizomorph system of which may extend some feet ahead of the rotten portion of a root. Collar inspection will therefore detect a tree while in the very early stages of infection, and successive inspections can bring a stand through a heavy attack without the loss of more than about 20 per cent of the infected trees. With regard to *Ganoderma pseudoferreum* and *Fomes noxius,* the rhizomorph systems of these parasites rarely extend more than a few inches in advance of root penetration, so that the method, though equally effective in indicating sources of infection, is less effective in preventing losses of young trees. Fortunately, however, the total number of infections caused by these parasites is usually small compared with the number caused by *Fomes lignosus,* so that a greater proportional loss of stand under treatment is of little importance; the main object is to detect and remove the sources of infection.

The depth of inspection should vary with the size of the trees. At one year from planting a 2 inch exposure of the tap root is sufficient for the amount of inspection required. At two years this depth must be increased to 4 inches, at three years to 6 inches, and at four years to 9 inches if the soil is particularly deep. A 6 inch exposure is usually sufficient for larger trees. Exposure must always be deep enough, however, to reveal the undersides of the surface laterals.

When inspecting stumps, dig the soil away from the bole to a depth of about 12 inches, and examine the exposed surface for signs of rhizomorph systems. Stumps infected with *Ganoderma pseudoferreum* and *Fomes noxius* are not difficult to detect with a little practice. There are however, numerous soil and wood rotting fungi which produce white mycelia somewhat resembling the rhizomorphs of *Fomes lignosus,* and difficulty is experienced in identifying this parasite on rotting timber. In this connection it is best to remove only those stumps which bear heavy and unmistakable rhizomorphs of *Fomes lignosus.* Of the doubtful stumps the great majority will be harmless, while those which bear true *Fomes lignosus* will be disclosed in future rounds of treatment.

TREATMENT OF INFECTED TREES

The sequence of operations in treating an infected rubber tree is as follows:

a Open the root system further until the whole extent of the invading mycelium has been exposed. This will disclose the source of infection, if still in existence.

b Remove the source of infection, following its ramifications systematically until all infected material has been disclosed

and eliminated. This work should be carried out in conjunction with inspection of any adjacent stumps.

c Prune the root system of the tree to remove all tissue which has been penetrated by the parasite.

d Wash the remainder of the infected portion of the root system, *i e* those roots carrying purely superficial mycelium, with a cheap fungicidal solution. A two per cent solution of copper sulphate is suitable, and should be applied gently with the hand, or with a cloth, after the larger rhizomorphic strands have been pulled away.

Trees which are already dead, or are too heavily infected to justify treatment, should be eradicated and the sites dug over to remove any undetected sources of infection. The sites may then be supplied.

This article was originally issued as Advisory Leaflet P/AL 1 (49); reprints are available on request.

PATHOLOGICAL DIVISION

Classification of Malayan Rubber Soils

A classification of the soils of a country is essential if a satisfactory land utilisation policy is to be operated. No intensive survey of Malayan soils has yet been started, and our knowledge of local soils and their properties is only slowly increasing. The publication last year of a 'Provisional Classification of Malayan Soils', by G. Owen, as Communication 274 of the R.R.I. Journal, appeared fifteen years after the last similar publication on the soils of this country and is therefore more than ordinarily welcome.

The basis of classification is parent geological material, and fourteen soil series are named after the districts in which they appear most typically. In addition, the soils are considered on the basis of relative fertility for growing rubber trees, and attention is drawn to the value of the alluvial clays (Selangor Series) for more intensive cultivation with foodcrops.

Bogor Conference, July 1952

Three papers were contributed by the Soils Division at the Conference of Rubber Research Institutes at Bogor, Java, and were read by the Soils Chemist, G. Owen. Their subjects were 'Chemical Weed control on Rubber Estates in Malaya' by C.G. Akhurst; 'Studies on the Phosphate Problem in Malayan Soils' and 'Determination of Available Nutrients in Malayan Soils', both by G. Owen. During the conference preliminary discussions were held at which proposals were drafted for assembling and comparing information on rubber soils of the various countries. Information will be interchanged between soil workers in each area on the description and properties of the main soil types. The growth and field performances of two standard clones Tj. 1 and P.B. 86, will be used to help in assessing the fertility of the soils.

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